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B8T
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GB 1161903
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(54) Pilfer-apparent closures

(57) A composite pilfer-apparent closure system comprising in combination a moulded plastics container (1) and a screw-threaded moulded plastics cap. An intermediate member (18) preferably an annular metallic ring coated with a thermoplastic film on its upper and lower surfaces is interposed between the said container and cap and is retained in pressure contact with each under the action of the engaging screw threads (2). This composite assembly is rendered pilfer-apparent by the action of an externally applied alternating magnetic field which causes a rapid temperature rise in the metal ring thereby softening the aforementioned plastics film to the point where the bonds or welds are formed with both the closure and the container at the points of pressure contact (W1 and W2). This locks the closure securely to the container through the intermediate member thus rendering the pack unopenable until the pilfer-apparent band (15) is removed in the normal way.

Normal unscrewing of the cap brings fingers (20) into contact with shoulder (6) on a tangibly connected top section (4) of the container (1). Continued unscrewing separates the top section from the container thereby exposing the product. The removable top section (4) is retained within the cap by the fingers.

A vital aspect of this composite system is the high degree of sterility provided by the bonds (W1) and (W2) which effectively seal the top section of the container preventing ingress of contaminants, bacteria etc. up to the point of use. Bonding in this manner is described in conjunction with a variety of closure types.

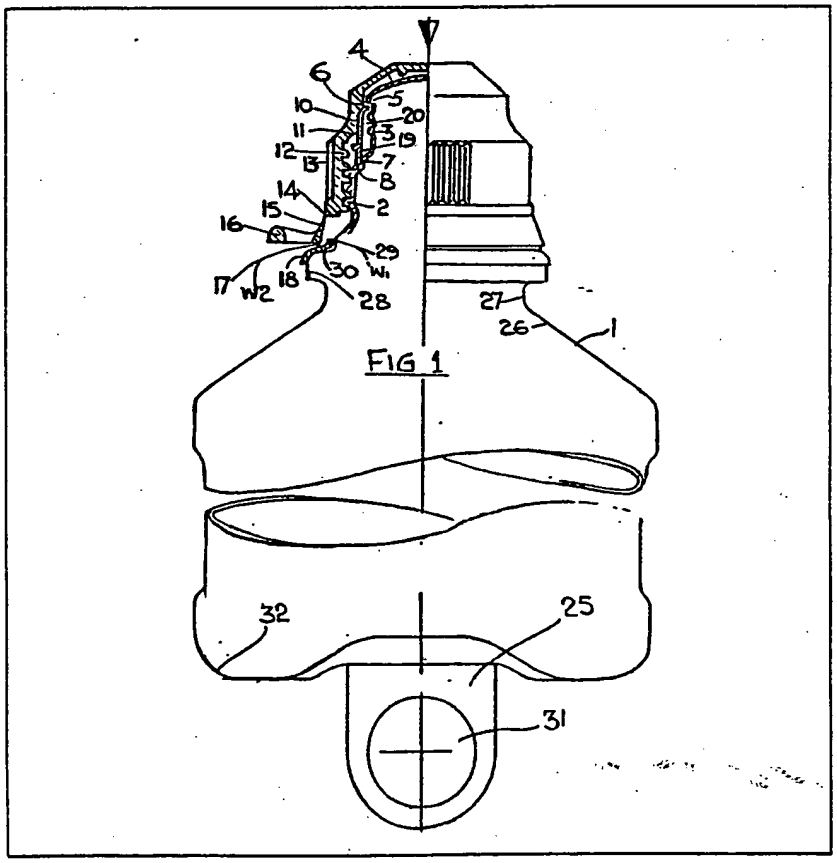

FIG 1

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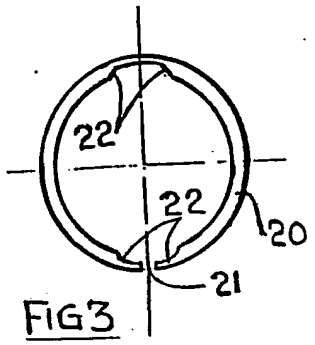


FIG3

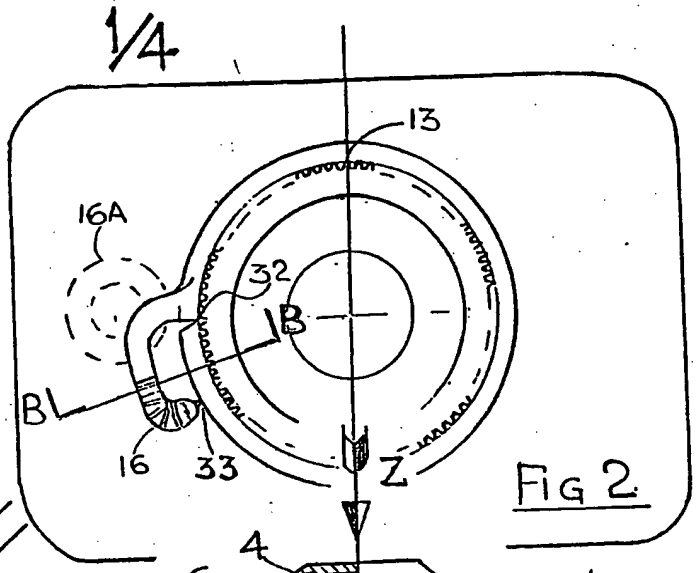


FIG 2

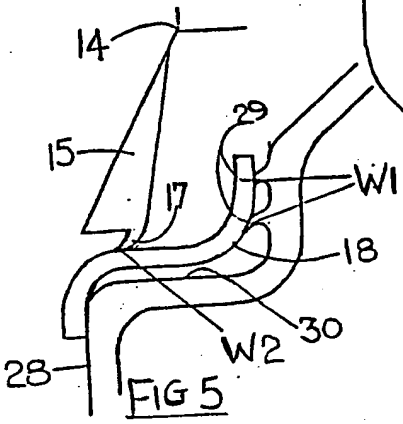


FIG 5

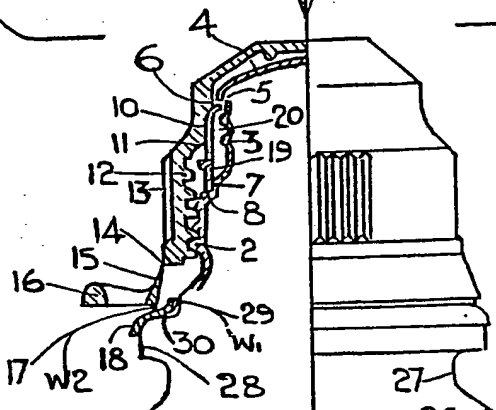


FIG 1

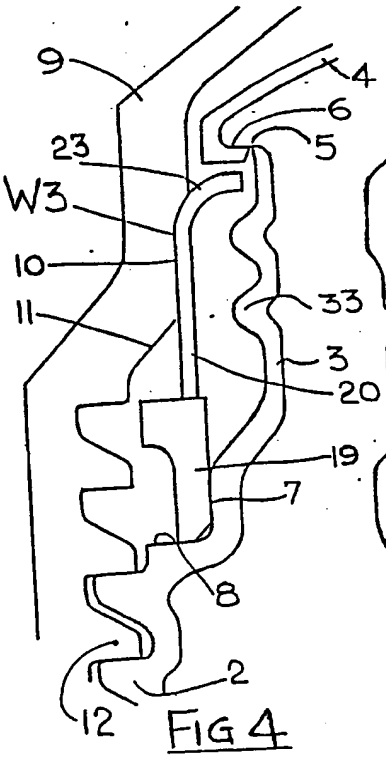
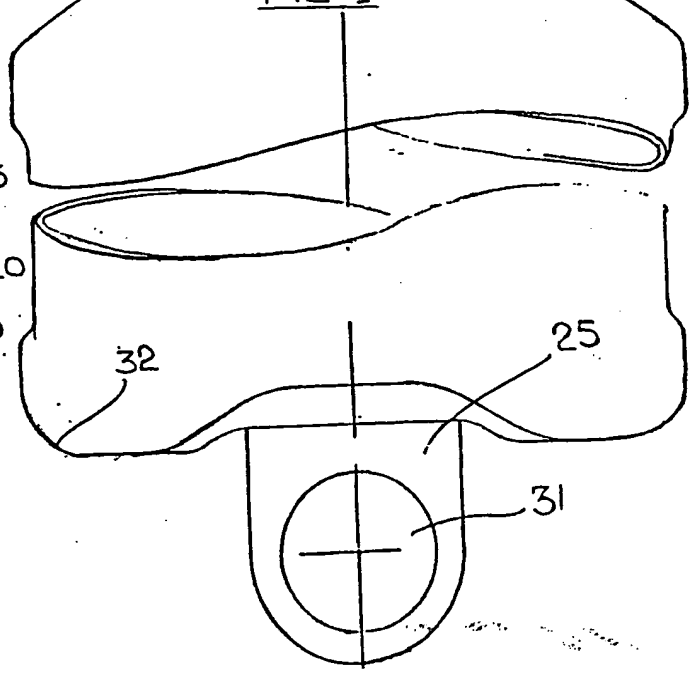


FIG 4



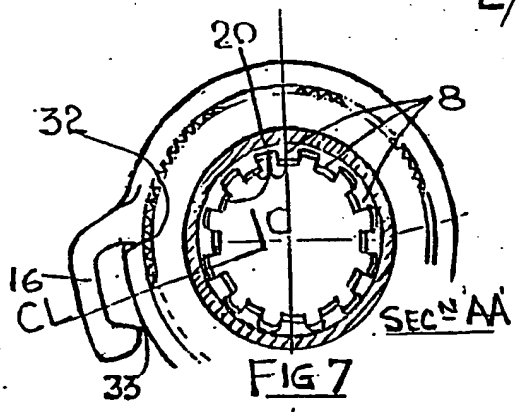


FIG 7

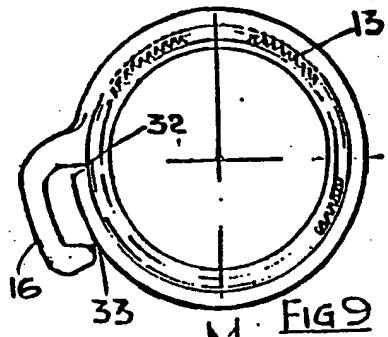


FIG 9

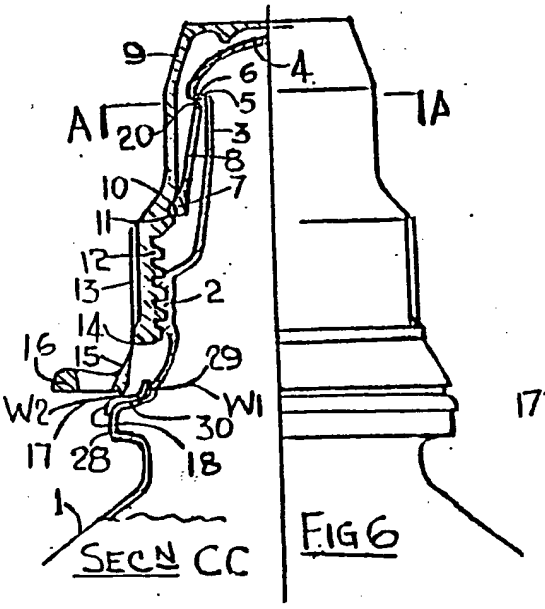


FIG 6

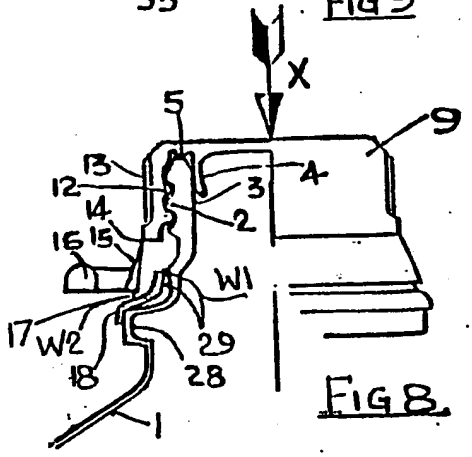


FIG 8.

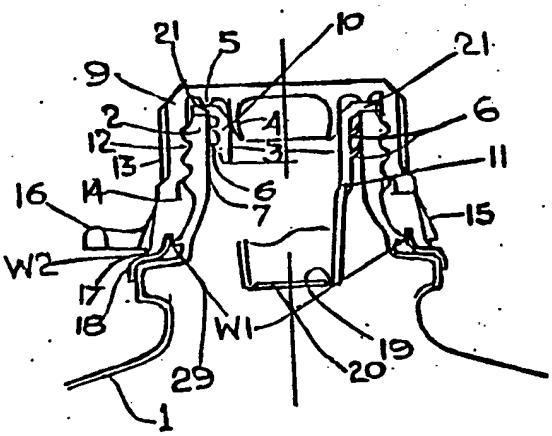


FIG 10

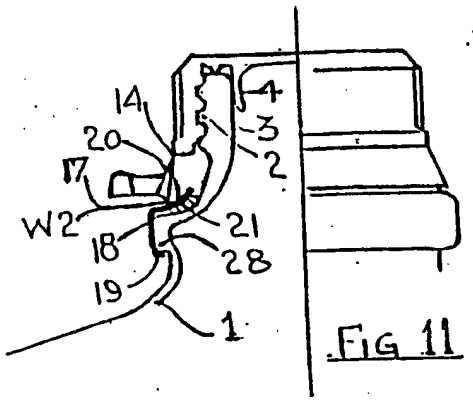


FIG 11

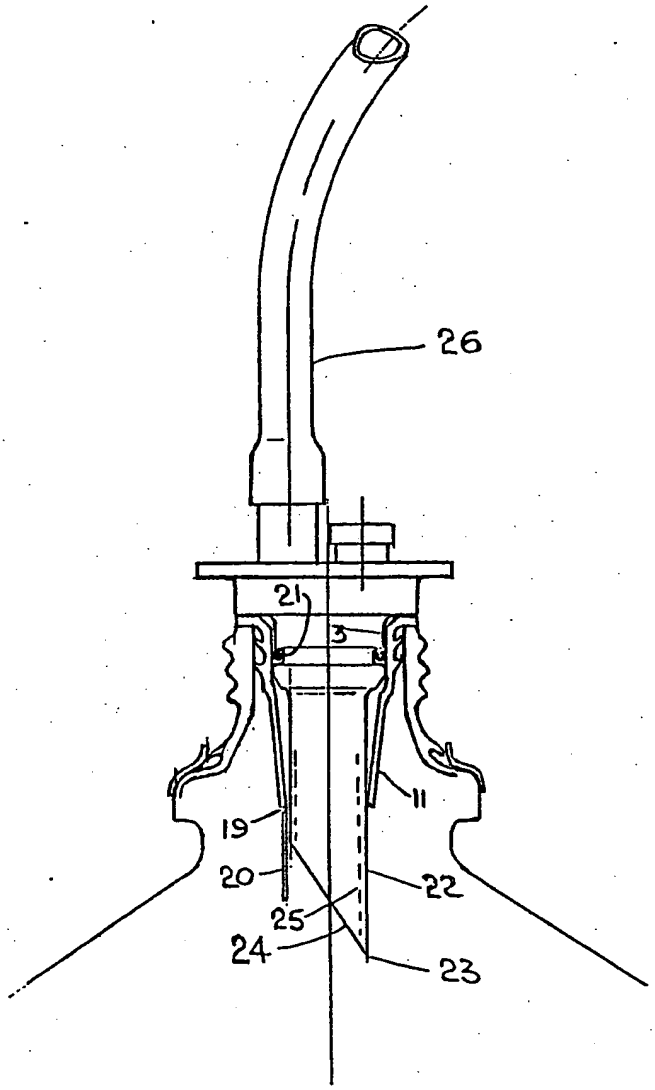


FIG 10a

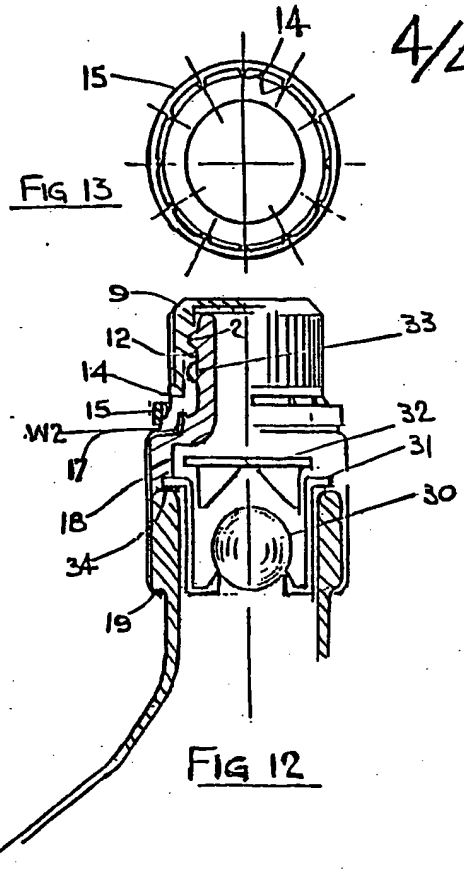


FIG 13

FIG 12

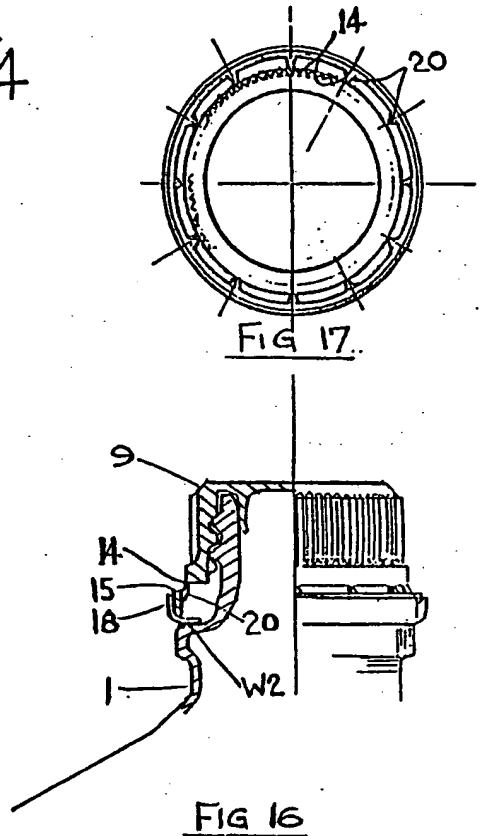


FIG 17

FIG 16

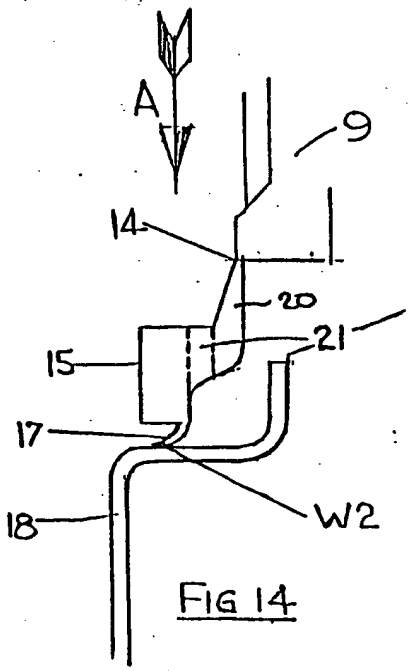


FIG 14

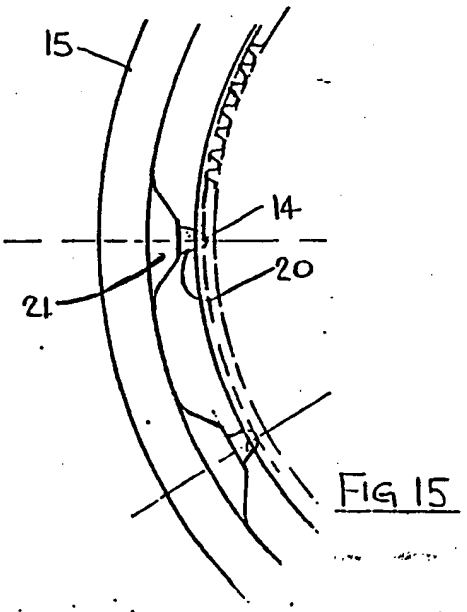


FIG 15

VIEW ON ARROW A

SPECIFICATION

Composite pilfer-apparent closure systems (For general and specific applications but with particular application to sterile packaging and to bottled spirits etc. in conjunction with non-refillable fitments)

This invention relates to a composite pilfer-apparent closure system which may be applied to a variety of container designs in various materials, and which will (a) enhance the security of the product by providing evidence of tampering and (b) in addition to (a) produce in certain embodiments an externally sealed closure system which provides a sealed region around the container opening and bounded by the internal profile of the closure.

This latter feature is of considerable importance when packaging sterile fluids e.g. water and other solutions used in clinical environments such as hospital operating theatres. Such closure systems may also be used for packaging of sensitive substances where chemical and/or bacteriological purity is important.

Pilfer-apparent closure systems are extensively used for packaging a great variety of consumer products, such as fruit juice, edible oils, motor oil, anti freeze etc. and are an accepted means of ensuring that product quality is not diminished by tampering. In the majority of applications the closure is locked to the container by some mechanical means, and removal of the closure requires the destruction of that part of the closure designed for this purpose, thereby permitting removal and leaving permanent evidence of such removal. Destructible features such as frangible bridges and tear-off rings are the most commonly used. In most examples known to the applicant, the closure and the container engage directly with each other and are mechanically interlocked together in a manner which prevents unscrewing or removal. Pilfer-apparent closure systems are also used in more specialised forms of packaging where direct welding or adhesive bonding of the closure to the container is used to provide the mechanical lock and additionally to provide a secondary seal which adds to the sterile quality of the package.

Examples of such packs are—

(1) McGaw sterile pack manufactured in the U.S.A. and distributed in the U.K. by the Boots Coy Nottingham. This pack employs the direct welding technique (i.e. direct application of heat to joint faces) and utilises a screw threaded annular ring to rupture this weld by screwing action as the first stage of opening. The disadvantages of this system are the difficulty in obtaining consistent quality of the welds, the weld quality is not visible, the weld may be partially ruptured prior to use without detection.

(2) The direct-bonding technique is used to produce a sterile pack in conjunction with a form, fill, seal type container by the Fresenius Coy, West Germany and distributed in the U.K. by Dylade Pharmaceuticals Runcorn. In this case the lower portion of the closure is bonded to the container using a hot melt type adhesive, the closure is released by a frangible section detached by a pull ring. The major disadvantage of this system is the difficulty in obtaining a satisfactory bond due to the nature of the materials involved (i.e. polypropylene and polyethylene resist adhesives)

The composite closure system which is the subject of this patent application differs from all other types known to the applicant in that it embodies an intermediate member between the closure and the container which under the action of externally applied radiation (e.g. high frequency alternating magnetic field) undergoes a rapid rise in temperature such as to cause melting and bonding of the thermoplastic material in pressure contact with it thereby providing a locking means between the closure and container and at the same time providing a secondary seal. This intermediate member is preferably a metal which has been coated with a thermoplastic material such as polythene or polypropylene but in certain cases may be uncoated metal, or metallic filled polymer which exhibits the required temperature increase on exposure to previously described magnetic radiation.

Since this composite closure system may be used in two basic forms i.e. sterile and non sterile, and in conjunction with containers made from thermoplastic materials and glass, the various embodiments will be described beginning with the most complex i.e. sterile application and subsequent embodiments will be described with reference to it.

With reference to the accompanying drawings *Figures 1–10* refer to sterile containers produced from thermoplastic materials such as polythene or polypropylene.

Figure 11 illustrates a glass container with a sterile type closure system.

Figures 12–15 represent a non sterile application of the pilfer-apparent closure system with particular reference to the packaging of spirits in glass containers in conjunction with non-refillable fitments. In this embodiment use is made of the metal cowl which in many instances is used to secure the fitment to the bottle neck, this cowl now becomes the intermediate member to which the pilfer ring may be bonded as previously described.

There are numerous varieties of non refillable fitment in common use. Examples of the type now referred to are—

United States Patent 3,810,558
British Patent 1,335,658
British Patent 835507

Figures 16–17 represent a basic, general purpose embodiment of this invention which

may be applied to a glass or plastic conventional container. In this embodiment and in particular with reference to a glass container the metal ring must be coated with a thermoplastic material such as polythene of surlin which will provide a mechanical bond at the interface of sufficient strength to resist any normal attempt to remove without detection.

With reference now to each of the specific embodiments of this invention the first described relates to a sterile package and particularly to a thermoplastic package of the form fill seal type used to package water and other fluids for use in clinical environments. Such packages are known to the applicant and are most economically produced using the integrated, form, fill and seal technique in which the container is first formed by the blow moulding process, filled with fluid and sealed while the container is still in the forming mould. In this process the filling takes place through the open neck of the container, immediately after forming and before the container material has cooled appreciably below melt temperature. After filling, a secondary moulding operation seals the opening and forms the head section of the container immediately above the neck opening. The filled package is then ejected from the mould when the cooling time has expired. A feature of this process is the creation of a weakened zone circumferentially surrounding and close to the neck opening, this weak zone or membrane therefore joins the neck opening to the head section. The packaged contents are exposed for use by mechanically rupturing this annular membrane immediately prior to use. Packs of this type are known to be produced on the "ROMMELAG form, fill" machine by the West Midlands Health Authority, Wolverhampton, and by Fresenius Pharmaceutical Packers (West Germany).

Although the process permits a high degree of inherent cleanliness it is normal to expose the sealed pack to standard sterilisation conditions as appropriate using an autoclave or other recognised method.

Two types of sterile package are known to be produced by the above process, and differ only in the manner in which the package is opened immediately prior to use. In the first case the package is sterilised after moulding, filling, sealing, etc. and is ready for use without further attention. To expose the contents for use the container head section is struck a sharp angled blow using the heel of the hand thereby rupturing the membrane (previously referred to). This method has the apparent advantage of cheapness, but in reality displays numerous disadvantages particularly the uncertainty and inconsistency of striking action performed by various operators and for this reason it is not used extensively. The second variety of packs of this type, employ a screw threadedly engaged cap or closure which is assembled to the container before or after sterilisation, the cap acts initially as a protective cover thus allowing a weaker membrane for ease of opening. The cap which is usually made from a thermoplastic material such as polyethylene or polypropylene is injection moulded and incorporates such features as screw threads, pilfer-band, pull ring etc. The cap is also used in the opening process to give consistency and ease of operation. Packs employing this system usually include a pilfer-proofing system which must be destroyed before the package can be opened. In such systems the opening procedure is as follows—

(a) remove the "anti-pilfer" feature

(b) the completion of (a) allows the cap to be further engaged on the container neck via the interacting thread forms. This action brings a reaction shoulder on the cap into pressure engagement with a corresponding shoulder on the head section of the container, such that any further rotation of the cap to increase the thread engagement produces an axial force on the head section urging it to move axially towards the container body, thereby rupturing the weakened membrane in a mechanically controlled manner. It is also a feature of such systems to provide a retention feature within the cap to retain the detached head section from the container. (c) Normal removal of the cap by unscrewing removes the head section with the cap and exposes the pack contents by providing an opening around the neck section at its uppermost end. The contents are now ready for use. Examples of this type of pack are manufactured and marketed in the U.K. by West Midland Sterile Supply Unit, Wolverhampton, and by the Fresenius Company, W. Germany Ref: European Pat. Appln. 0,050,490. In all examples of this latter type known to the applicant (i.e. where the cap is used to open the pack) it is necessary first to further engage the interacting screw threads of the cap and container to rupture the membrane after which an unscrewing action is required to expose the contents. This double action is sometimes confusing to operatives and is considered a disadvantage. A further limitation of these packs is their inability to provide a truely sterile zone around the pouring orifice, i.e. under the cap, due to difficulty of sealing this zone hermetically.

It is an object of this present invention to provide a sterile package which overcomes these disadvantages and provides a composite closure system which permits a sterile zone underneath the cap and which exposes the contents in one simple unscrewing action rather than two.

In essence this first embodiment is produced in the same manner as that already discribed i.e. the form, fill, seal integrated process, and the container incorporates a fran-

gible membrane as described earlier. The closure system in this case is more complex than those described earlier and consists of a number of parts separately assembled into the neck of the container and interferingly pressed into consolidated relationship by the screw threaded engagement of the cap with the container as the final assembly operation. This consolidated assembly is made functional by the action of a high frequency alternating magnetic field on certain plastic coated metal parts of the composite closure assembly, producing welds or bonds in pre-determined regions of the assembly thus providing the necessary hermetic seal and mechanical strength requirements of the system. This composite closure system employs plastic coated metal parts which under the action of the radio frequency (R/F) magnetic field experience a rapid temperature rise resulting from the eddy currents induced within the metal structure. This increase in temperature sufficient to melt the thermoplastic materials is transmitted through the thermoplastic coating and into any surrounding areas in contact. The materials chosen for the various parts of this composite system including the coating materials are such that welds or bonds are produced at the plastic interfaces which are designed to produce the type or joint required, i.e. mechanical strength, or hermetic seal with rupture properties. The metal chosen for the application should be non-toxic, have good mechanical, thermal and corrosion resistant properties, in addition to being amenable to conventional metal forming processes e.g. pressing, rolling etc. for example an aluminium alloy in rolled sheet form would be suitable.

In essence the composite closure system is assembled to the neck of the container as follows—Firstly a plastic coated annular metal ring is assembled to the lower portion of the top of the container, below the threaded section, this metal ring is coated with a thermoplastic film on its lower surface (in contact with the container) which is weldably compatible with the container material, and its upper surface (in contact with the closure) is coated with a thermoplastic material compatible with the closure material.

Next a plastic bush is assembled to the top section of the container being located and retained by a shoulder just above the threaded section. This part merely acts as a distance piece and is discarded after first opening if it is intended to use the closure as a reseal by providing the space to allow increased thread engagement of the closure and container.

Next a split thermoplastic coated metal sleeve is assembled over the head section by outwards springing to clear the head diameter, and coming to rest on top of the distance sleeve where it springs back to its original diameter underneath the head section which of necessity is of greater diameter than the adjoining neck section. The split sleeve has at it's upper end an inwardly formed radius, which produces a through diameter less than that of the head diameter, for this reason the sleeve is split axially to permit assembly by springing. The split sleeve is now in position around the neck section and with its radiused upper end directly underneath the head section. Finally the cap itself is assembled. It consists of a screw threaded body portion having a knurled exterior, the lower portion, i.e. the pilfer band, is attached to the body by a thin circumferential membrane. A vertical membrane runs axially through the pilfer band from the open end of the band to the circumferential membrane, and a pull tab at the lower end of the band bridges each section of the pilfer band across the membrane. The pull tab is rigidly attached to the band at one end adjacent to the membrane and frangibly attached via a bridge at its other end. The cap is assembled to the top section of the container where it engages screw threadedly. As the cap is applied, it engages with the radiused upper end of the split sleeve, compressing the sleeve and forcing it into position within the upper section of the cap until it comes into final location with the radiused end nesting in a corresponding profile within the cap. At its lowermost end the pilferproof band engages the annular ring and forces it interferingly into its locating diameter below the threaded section. The lowermost surface of the pilferproof band (i.e. that in contact with the annular ring) has a sharp downwards projection where it contacts the ring. This forms a rupturable sealing membrane between the cap and the ring after bonding (i.e. by exposure to R/F magnetic field). The ring is bonded to the container around the location diameter (during the same R/F exposure) thereby providing a sealed region between the cap and the container which is subsequently sterilised. In addition to producing these bonds the R/F magnetic exposure also bonds the upper split sleeve to the cap body around its location diameter thereby providing considerable mechanical strength to the sleeve particularly the upper radiused portion, this is necessary to transmit the opening force from the cap to the container head section during opening.

Opening of the package is straighforward namely—remove the pilferproof band by breaking the bridge attaching the free end of the tear tab and pulling the tab outwards. This action places high localised stresses on the verticle membrane which fractures, and transfers the stress into the upper and lower circumferential membranes which progressively rupture as the band is pulled by the tab, until it comes away completely. Prior to removing the pilferproof band the cap is rigidly attached to the container through the bonded junctions

and cannot be removed thus imparting a pilfer apparent quality to the cap. Having been released the cap may be now unscrewed in the normal manner. Upward movement of the cap brings the uppermost radiused end of the split sleeve into abutting contact with the underside of the head section of the container, further upward movement fractures the membrane joining the head to the neck of the container.

Complete removal of the cap exposes the contents and retains the detached head section within the cap. The container may now be used as a "pour" type or by insertion of a purpose designed adaptor into the orifice the container may be used in the inverted position for urological or similar remote use applications in co-operation with a "giving set". (Fig. 10a).

The package may be reclosed by discarding the distance bush and re-applying the cap, this re-engages the detached head section over the neck and effects a seal sufficient for most purposes. Should a high quality re-sealing performance be required, the neck station below the opening incorporates a conventional screw thread which will engage a separate closure with built in sealing plug. This secondary threaded portion may also be used to retain the feed end or adaptor portion of a giving set (i.e. flexible tube arrangement for conveying sterile fluid to point of use).

The first embodiment of this invention will now be described with reference to Figs. 1–5 of the accompanying drawings in which *Figure 1* is a side elevation of the complete pack partly in section showing in section the composite cap and container assembly.

Figure 2 is a plan view of the complete pack looking onto the top in the direction of arrow Z.

Figure 3 is a plan view of the split aluminium sleeve looking in the direction of arrow Z.

Figure 4 is an enlarged sectional view of the interface between the cap, the lower sealing ring and the container.

Figure 5 is an enlarged sectional view of the neck and head section of the container/cap assembly.

Referring now to Figs. 1 and 2, a container 1 is formed from a plastic material such as polypropylene on a machine having the capability of filling the freshly moulded container with the required fluid through the neck opening prior to the formation of the head section 4 as the final operation which seals the product within the container. The blow moulded container 1 consists of a body section 1 having a shoulder 26 terminating in a circular section 27, and which is joined to the top section of the container via a handling flange 28. The region above flange 28 will be referred to as the body section, which terminates in a free standing base section 32 which may incorporate a hinged feature 25 which enables the pack to be suspended in the inverted position via the hole 31 when the pack is used for urological or similar "remote-use" purposes.

The top section of the container consists of a neck section 3 running into a threaded section 2 via a cylindrical section 7 and a square shoulder 8 Fig. 5. The threaded section joins the handling flange 28 via a cylindrical portion 29 and a shoulder 30 Fig. 4. At its upper end the neck joins the head section 4 of the container via a shoulder 6 and a membrane 5 Fig. 5. The membrane 5 is produced at the blowmoulding stage by the combined action of the blowpin which is inserted above the shoulder 6 and the mould profile which incorporates an inverted "V" section at this point squeezing the plastic material in a controlled manner which produces the membrane 5 to a precise and consistent thickness which is substantially less than that of the adjacent parts of the container. The membrane 5 is thus a precisely formed weak annulus completely surrounding, and directly adjacent to the neck.

The composite cap arrangement is made up of a number of separate parts assembled over the top section of the container as follows — Firstly the lower sealing ring 18 is applied and rests on the conical surface leading to the fitting diameter 29. The annular ring 18 is pressed from a metallic material which has previously been coated on both surfaces with a thin film of thermoplastic material. The purpose of this coating is to produce effective bonds/welds to both the material of the container (e.g. polypropylene) and of the cap (e.g. polythene) the coating material must therefore be weldably compatible with that of the cap and container, i.e. have similar melt temperature and molecular structure. The ring material is preferably aluminium but not exclusively so. Next to be assembled is the distance bush 19 this is a simple thermoplastic moulding cylindrical in shape with a small flange at its upper end which serves to provide a location platform for the split aluminium sleeve. The lower end of the bush 19 is located by diameter 7 and shoulder 8 of the container. Next to be assembled is the split aluminium sleeve 20 which is coated on its outside surface with a thermoplastic material similar to the lower annular sealing ring. The split sleeve 20 is basically a cylinder the upper portion of which is formed into a small radius facing inwards. The ring is split along its length leaving a gap and providing the flexibility necessary to permit assembly. Initially the ring is sprung outwardly to permit the radiused upper end to pass freely over the head section of the container after which it comes to rest on the flange of bush 19 and returns to its unsprung dimensions bringing the radiused portion underneath the head section of the container. The split sleeve is then

compressed by the action of the cap 9, as it is applied forcing the split ring into its final location 10 and increasing the abutment area under the head 4. Compression of the split sleeve 20 is facilitated by the gap 21 Fig. 3 and is initiated by the action of the inclined surface 11 of the cap 9 engaging the radiused upper end 23 of the split sleeve Fig. 5, under the action of the engaging threads 12 between the cap and the container. The cap incorporates a pilfer-proof band 15 at its lower end, this band is attached to the skirt of the cap by a precision moulded circumferential membrane 14. The lowermost surface of the band incorporates a small raised circumferential projection 17 facing downwards. The band also incorporates a vertical notch 32 Fig. 2 extending axially between the membrane 14 and the projection 17, the apex of this notch being a membrane of similar proportions to the circumferential membrane 14. A tear tab 16 projects from one end of the notch 32 and is curved to provide a good finger grip, the gripping end is re-attached to the band by a small frangible bridge 33, which is easily fractured in the opening sequence. The bridge 33 serves to protect the membrance 32 from accidental damage, it's fracture may indicate damage to the membrane 32 which is a useful safeguard. The final stages of assembly of the cap 9 not only engages the split sleeve 20 as already described but also engages the lower aluminium sealing ring 18 on its location diameter 29. This diameter may have a small deformable projection extending radially outwards and which under deformation provides a circumferential interference with the bore diameter of the ring. The sharp downwards projection 17 on the pilferproof band is also deformed by contact with the uppermost surface of the sealing ring 18 as its forces it into position, thus ensuring complete annular contact between the projection 17 and the thermoplastic coating on the ring 18.

The composite closure/cap assembly is now complete and rigidly consolidated on the top section of the container ready for exposure to a Radio-frequency (R/F) magnetic field. The R/F action produces a rapid temperature increase in the metal parts with subsequent heat transfer through the plastic coating and into adjacent regions where pressure contact exists namely around the interference region of the bore of lower ring 18 producing a weld W1 Fig. 4, also between the projection 17 and the coated upper surface of the ring W2 Fig. 4. These welds/bonds provide a seal between the cap and container thereby providing a zone under the cap which is sterilisable. In addition a weld is produced between the coated split sleeve 20 bonding the ring to the cap at W3 Fig. 5. This bond imparts mechanical strength and rigidity to the ring particularly adjacent to the upper radiused portion which is used to fracture the head membrane 5 of the container during opening. Weld W2 is a multifunctional weld and must be designed with due consideration of these functions namely—(1) it provides a hermetic seal between the closure and ring and in this respect is similar to weld W1. (2) in addition W2 also renders the cap 9 immovably attached to the container i.e. normal unscrewing is not possible. (3) weld W2 will rupture under the stress concentration produced by pulling the tear tab in the prescribed manner. An alternative pull-ring is illustrated by 16A Fig. 2.

To open the package after sterilisation, the bridge 33 is broken thus detaching one end of the pull tab from the band, the pull tab is then pulled away from the band using the hook-shaped free end. This produces a very high local stress concentration at the base of the vertical membrane 32 where it joins the circumferential weld W2. Rupture here progresses through membrane 32 and into membrane 14. Further outward pulling accompanied by bending of the pull ring 16 causes progressive rupture of the upper membrane 14 and the lower weld W2. This action is continued until the pilfer-proof band is completely detached from the skirt of the cap, which is now free to be removed by normal unscrewing. Unscrewing the cap 9 brings the radiused portion 23 of metal sleeve 20 into abutting contact with the underside 6 of the container head section 4 in close proximity to the membrane 5 which joins the head to the neck of the container. The engaging threads 12 are designed to maximise the upward thrust produced by the unscrewing torque on the shoulder 6 of the head thereby causing rupture of the membrane 5.

Further unscrewing releases the cap from the container with the detached head section 4 retained within the upper portion of the cap 9. The contents may now be used as required. Resealing may be effected by removing the distance bush 19 thereby providing clearance to permit the cap to be re-engaged to a greater extent allowing the head section to fit over the neck section thus providing a seal adequate for most purposes. The cap 9 is preferably made from a thermoplastic material such as high density polythene suitably modified to give minimum frictional interaction with the container, and having strength properties i.e. rupture performance in keeping with the requirements for opening the package. The secondary screw thread 33 on the neck section 3 of the container may be used to engage a separate closure having a sealing means such as a liner, plug, etc. to provide a high quality seal if that is required. Alternatively the thread 33 may engage a retaining sleeve which secures the probe section of a giving set etc. should the container be used for urological or similar remote use purposes.

A second embodiment of this invention is illustrated in Figs. 6 and 7 of the accompanying drawings where Fig. 6 represents an alternative cap design shown in part sectional elevation assembled with the container. Fig. 7 represents a sectional view looking downwards on the assembly through plane "AA". This design is based upon Fig. 1 but simplified by the deletion of the distance bush, and the split aluminium sleeve is replaced by the plastic moulding 7. The insert 7 is injection moulded and consists of a lower body section which is tubular and incorporates at its lowermost end an outward facing circumferential bead 10.

The upper section of the insert is formed by a number of flexible inwardly inclined fingers 8 Fig. 7.

The insert 7 is pre-assembled into the cap 9 (prior to application to the container) it is pressed into location within the cap and retained by the snap engagement of the bead 10 with the groove 11 in the cap. This design is arranged to permit ease of engagement coupled with high retention properties which resist any tendency of the parts to disengage. The lower sealing ring 18 Fig. 6 is similar to that described previously but in this case the underside of the ring bears directly on the upper surface 30 of the shoulder 28 providing a reaction face for the cap. There will therefore be additional welding/bonding in this region, but in essence the same sealing and rupture requirements as previously described will also apply here. As the cap is applied the flexible fingers 8 spring outwardly as they pass over the head section 4 of the container, returning to their natural position under the head section and surrounding the membrane 5 which joins the neck section to the head section. The upper surfaces of the fingers 20 produce an abutment with the underside of the head on shoulder 6. During opening the proceedure for which is identical to that previously described the reaction surfaces 20 engage with the annular shoulder 6 producing an upwards force on the head section 4 and the membrane 5, which ruptures thereby detaching the head section as previous. The fingers are so arranged to flex outwards to permit easy assembly of the cap but to become rigid in compression during the opening stage thus providing an efficient means of transmitting the thrust produced by the engaging screw threads 12 to the head section and to the membrane 5. The engaging screw threads of the cap 12 and the container 2 are designed with upward facing reaction faces, and are close pitched in order to maximise the axial force produced by the unscrewing torque applied to the ribbed body section 13 of the cap during removal.

Further embodiments of this invention for sterile applications are illustrated in Figs. 8–11 on the accompanying drawings. In this grouping the composite closure assembly is designed for use with a container produced in the conventional manner (in glass or plastic materials) and having an opening capable of being sealed by a plug type insert. Containers of this type are filled with product as a separate operation after moulding. The sterilising operation will normally take place after the cap (which in this instance is the closure) has been fitted. With reference to the accompanying drawings Fig. 8 represents in part sectional elevation a container and composite closure assembly where the container is conventionally produced from a thermoplastic material such as polythene or polypropylene, the closure is also produced in a thermoplastic material such as polythene or polypropylene and the intermediate member is a metallic annular ring which is coated with a thermoplastic layer or film. Fig. 9 is a plan view on Fig. 8 in direction of arrow "X". Fig. 10 is similar to Fig. 8 and represents a dual purpose pack, which by prior selection of bore insert (i.e. open or closed end) may be used as a "pour type" or "remote use type" in conjunction with the necessary appendages i.e. "giving set" etc., Fig. 10a the same closure and container being used in each application. Fig. 11 represents in part sectional elevation in combination a conventional glass container, a thermoplastic closure and a "rolled-on" coated metallic ring as the intermediate member, to provide a pilfer-apparent sterile package in glass.

Each of these embodiments will now be described with reference to the accompanying drawings. With ref. to Fig. 8, a container 1 is produced in a thermoplastic material such as polypropylene by conventional means such as blowmoulding. The container incorporates a screw threaded finish 2 at its open end, below which is a cylindrical region having at least one annular sealing fin 29 projecting at right angles from it, the diameter of the fin being in excess of the maximum diameter of the threaded section 2. Directly below the fined section is a flanged portion 28 which adjoins the container body 1. The shape and size of the container below this flange may be varied to suit the needs of the end user. The container opening has a chamfered entry to the bore section 3 which should have a quality finish in order to provide a good seal with the closure sealing plug 4. Prior to engaging the closure with the filled container the plastic coated metallic ring 18 is first assembled into position on the container neck section. This may be pressed into engagement or left as a loose fit to be finally positioned by the closure. The closure 9 is produced by the injection moulding process and consists of a body section having a knurled exterior 13 and screw threaded interior 12. The interior top section of the closure incorporates an integral sealing plug 4 and a small raised section 5

surrounding the plug which engages directly on the top surface of the container. The plug 4 fits interferingly with the container bore 3 to provide a liquid seal and is assisted by the chamfered entry to the bore. The closure incorporates a pilfer-proof band 15 at its lower end, this band is attached to the closure skirt by a precision moulded circumferential membrane 14 and is similar in all respects to the anti-pilfer band described earlier i.e. with ref. to Fig. 1 etc. in that it embodies all the same functional features namely vertical membrane 32, tear tab 16, rupture bridge 33 and downwards projection 17. The closure is engaged with the container by means of the screw threads and the final engagement may be used to force the ring 18 into position on the container neck where it engages interferingly with the sealing fins 29 which deform to permit assembly of the ring. The pack may now be sterilised and subsequently rendered pilfer resistant to exposure to R.F. radiation as previously described which induces welds at positions W1 and W2 Fig. 8 thereby locking the closure to the container via the intermediate ring member and also providing a sealed region bounded by the closure internal surfaces. Opening of the pack to expose the contents is as previously described i.e. the break bridge 33 and pull tear tab outwards thus rupturing membrane 14 and weld 17 on closure. The closure may now be removed by unscrewing to expose the contents for the first time. The closure may be re-engaged to provide a quality seal if required.

The embodiment illustrated in Fig. 10 is very similar to that of Fig. 8 with the exception that in this embodiment the pack is made more versatile by inserting into the container bore after filling a choice of two inserts depending on the end use requirements. Fig. 10 illustrates in sectional elevation the use of each type of insert. An open ended insert 10 is illustrated to the left of the centre line and a closed ended insert 11 is shown on the right. If a "pour type" container is required the open ended insert 10 is used and if a "remote use type" is required the closed ended insert is used, in this case the insert 11 is injection moulded in polythene or polypropylene and incorporates a closed end 20 attached to the side walls 11 by a thin frangible annular membrane 19. Both types of insert incorporate sealing fins 6 which engage interferingly with the container bore 7 to provide a liquid seal in addition to good insert retention and have a precision bore 3 which provides sealing engagement with the closure plug 4. After removal of the closure of the "pour type" i.e. with open ended insert is ready for use while the "remote use type" requires the insertion of the spike end of the probe on the "giving set" which progressively ruptures membrane 19 while coming into sealing engagement with bore 3 thereby permitting transfer of liquid via the "giving set" to point of use. Fig. 10a represents in part sectional elevation a "remote use type" of pack with the "giving probe" in position, the probe 22 having penetrated the membrane 19 initially by the sharp leading edge 23 of the inclined probe face 24 and then progressively as the probe is inserted leaving the closed end 20 of the insert retained to wall 11 by the remaining vestige of membrane 19 which acts as a retaining hinge and prevents the disc 20 from interfering with fluid flow through the probe bore 25. The probe 22 incorporates a liquid seal 21 which engages the insert sealing bore 3. Fluid is conveyed to a remote point of use via flexible tubing 26. (in this mode of use the container is inverted).

Fig. 11 illustrates in part sectional elevation a pilfer-apparent composite sterile closure system in combination with a glass container. The glass container 1 is produced by conventional means and embodies a threaded section 2 around the opening 3 below which is a flange 28. Prior to filling, the container 1 is fitted with a sealing member 21 which is an annular ring of resilient compressible material such as a silicone rubber. This ring rests on the upper surface of flange 28. A plastic coated metallic retaining ring 18 is now assembled over flange 28 and pressed firmly into the sealing member 21 by a downwards force exerted by an external means (not shown) upon the top surface 20 of the annular ring 18. Whilst this top force is applied the lower region of ring 18 initially straight sided is deformed inwardly by external means (not shown) to position 19 underneath flange 28 thereby trapping the resilient member 21 in sealing contact with the upper surface of the glass flange 28. This "rolled on" sealing ring 18 now becomes the intermediate member and its upper surface 20 which is coated with a suitable thermoplastic material provides the engaging surface for the closure pilfer band projection 17, and produces a weld W2 under the action of R/F magnetic radiation as in previous embodiments. The container should be produced with a chamfered entry to the bore 3 which must be of high quality to provide an effective liquid seal with the closure plug 4.

In all the foregoing cited embodiments of sterile packs it is indicated that the R/F welding operation is carried out prior to sterilising. In practice however this may be performed after sterilising with the cap or closure not fully engaged as this will permit steam to permeate the area under the closure allowing sterilising of this region at a slightly lower temperature than otherwise. In such a case the closure system would be fully engaged after sterilising and R/F welding would be initiated in a controlled environment as the final operation.

Figs. 12–17 represent non sterile applica-

tions of this pilfer proofing system, Figs. 12–15 refer to a specific application namely the packaging of spirits and wines in glass or plastic containers and in conjunction with "non refillable fitments (used to prevent dilution or replacement of the original product after first opening by incorporating a one way valve in the container opening). Fig. 12 illustrates in part sectional elevation a representative spirits container in glass and having a non-refillable fitment secured in the pouring orifice. Fig. 13 is a plan view of the closure. Fig. 14 illustrates an enlarged view of the closure/fitment interface high-lighting the anti-pilfer features. Fig. 15 is an enlarged part plan view (on Fig. 14) further illustrating these features. Many types and varieties of non refillable fitments are in common use and the illustration in Fig. 12 is intended to cover only those versions which are secured to the bottle opening by a metallic cowl. In this embodiment the metal cowl is coated with a thermoplastic film and becomes the "intermediate member" between closure and fitment in addition to its original retaining function. Fig. 12 represents a conventional bottle 1 having a flanged section 28 around the neck bore 3. Into this bore a representative fitment is assembled consisting of a lower body portion 31 to which is attached an upper portion 33 which is screw threaded 2. The valve mechanism is housed within the upper and lower members namely a spherical ball 30 and an intermediate table 32 serves to shield and retain the ball. In operation the ball 30 rests on its seating 35 in the fitment body when the bottle is in the upright position thereby preventing liquid being added to the bottle contents. In the pouring mode however the ball (which is guided within the fitment body) comes off its seating and rests against the underside of table 32 thereby allowing liquid to flow from the bottle by passing around the ball, through the fins 36 on the underside of the table 32 over the table and through the fitment pouring orifice as indicated by flow arrow (Fig. 12). The fitment is sealed to the bottle by means of a compressible sealing member 34 and is held in position by a retaining cowl 18 which is deformed radially inwards at its lower end 19 to provide locking engagement with the underside of flange 28 on the bottle. In this embodiment the cowl 18 is of metallic construction with a thermoplastic coating on its outer surface which is weldably compatible with the closure material. The closure 9 is produced by the injection moulding process in a thermoplastic material such as polythene or polypropylene and consists of a body section having a knurled exterior and a screw threaded interior 12. The interior top section of the closure may incorporate a sealing plug or liner to provide a liquid seal with the fitment with which it engages screw threadedly. The closure incorporates an anti-pilfer ring 15 at its lower end which is attached to the skirt in a number of frangible bridges 14 spaced at intervals around the circumference.

The underside of the anti-pilfer ring incorporates a flexible downwards projection 17 extending around the bore of the ring. The anti-pilfer ring 15 incorporates local reinforcements 21 and ramp like buttresses 20 which terminate at the bridge points 14 on the outer periphery of the closure skirt Figs. 14 & 15. This configuration permits downward force to be transmitted from the closure skirt to the anti-pilfer ring, during closure application, ensuring pressure contact between projection 17 and fitment retaining cowl 18 Fig.14, due to the compressive strength of features 20 and 21. After the closure has been applied the assembly is now subjected to R/F magnetic radiation as previously described thereby producing a circumferential weld W2 between anti-pilfer ring and retaining cowl where they contact i.e. around projection 17. This weld W2 locks the closure to the container via the anti-pilfer bond. Removal of the closure can only be achieved by breaking the bridges 14 and this is facilitated by the buttresses 20, which flex during the unscrewing action thereby inducing high tensile and shear stresses into the bridge junctions 14 causing fracture at these points thereby releasing the closure. The number of bridges required will depend on several factors namely (a) the closure material, (b) the cross section area of the bridge at the facture function (c) the opening torque requirements of the pack. In this example the anti-pilfer ring is retained on the container neck by the welded junction, but other variations would be equally effective namely a tear off anti-pilfer ring, which would be welded to the cowl at discrete points (i.e. projection 17 would not be continuous) the band 15 would incorporate a gap which would provide a free end used to pull the band away from the assembly thereby rupturing the bridges. Another variation would be to dispense with the "anti-pilfer" band 15 and use direct projections from the underside of the closure skirt, which would contact the retaining cowl at a number of discrete points around its circumference. These points would now form the frangible bridges after welding and would be sheared during normal removal of the closure.

Figs. 16 and 17 refer to general purpose applications of this invention in relation to a glass or plastic container, in which Fig. 16 represents a part sectional elevation showing the container/closure assembly, and Fig. 17 is a plan view on the closure showing the anti-pilfer features. In this embodiment the closure 9 is very similar to that described in Fig. 12 i.e. it is screw threaded on its inner surface, it incorporates a sealing feature (i.e. plug or liner) to provide a liquid seal with the

container opening an an anti-pilfer ring 15 attached to the skirt by frangible bridges. In this embodiment the intermediate member is a metallic annular ring 18 with an inward facing flange at its lower end. The ring is coated with a thermoplastic film on its inner and outer surfaces. This ring may be pre-assembled unto the closure anti-pilfer ring where it fits interferingly with the ring outside diameter. Application of the closure engages the underside of the metallic ring 18 with the upper surface of flange 28 on the container giving an annular area of pressure contact 19 between them. This downwards force is transmitted from the closure to the container via the bridges 20 which are strong in compression but relatively weak in tension and shear (i.e. as described with ref. to Fig. 12). In this embodiment the inside surface of ring 18 is coated with a thermoplastic material weldably compatible with the closure material i.e. poly propylene or polythene, the outer surface in contact with the container is coated with a thermoplastic film which will form a bond with the container under the action of R/F magnetic radiation and this will depend on the container material e.g. if the container is produced in PVC then the coating would be P.V.C. in the case of a glass container, a coating such as surlin would be used as it is known to produce a bond with glass under the conditions here described.

At the same time as this bond W2 is being formed the anti-pilfer ring is being bonded to the inside surface of the metallic ring at W1 thereby locking the closure to the container. Normal unscrewing action of the closure will rupture the bridges 14 giving evidence of first opening in the process. The contents of the pack is now exposed and re-sealing is effected by replacing the closure. Variations in this embodiment similar to those previously described in relation to Fig. 12 apply equally in this case.

CLAIMS

1. A composite pilfer-apparent closure system comprising in combination a moulded plastic container to which is attached screw threadedly a moulded plastic cap. An intermediate member preferably an annular metalic ring (coated with a thermoplastic film on its upper and lower surfaces) interposed between the said container and cap is retained in pressure contact with each; under the action of the engaging threads.

This assembly is rendered pilfer-apparent by the action of an externally applied alternating magnetic field which causes a rapid temperature rise in the metal ring thereby softening the aforementioned thermoplastic film to the point where bonds are formed with both cap and container at the points of pressure contact.

2. A pilfer-apparent closure system is claimed in claim 1 wherein the cap incorporates a pilfer-apparent band attached to the skirt through an annular frangible membrane. The band is provided with a tear-tab at its lower extremity adjacent to which is a line of weakness extending to the said frangible membrane joining the band to the cap skirt. The lower extremity of said band embodies a downward facing deformable projection.

3. A pilfer-apparent closure system as claimed in claim 1 in which the said container and intermediate member are interferingly assembled preferably via at least one deformable membrane projecting radially outwards from the said container neck where they finally engage.

4. A pilfer-apparent closure system as claimed in 1 in which the intermediate member is a metal ring preferably aluminium and coated with a thin film of thermoplastic material such as polyethylene or polypropylene on its upper and lower surfaces.

5. A pilfer-apparent closure system as claimed in (1–4) wherein the bonding of the aforesaid parts (claim 1) produces in addition to a pilfer-apparent assembly a secondary seal between the said cap and container, providing a sealed zone bounded by the internal profile of the cap.

6. A pilfer-apparent closure system as in 1–4 wherein the bond produced between the said cap and intermediate ring is rupturable, by a pulling action on the tear tab.

7. A pilfer-apparent closure system as claimed in 1–6 in which the container is a sterile package of the form fill, seal type wherein the uppermost section of the said container is frangibly attached to the container opening above the threaded region.

8. A pilfer-apparent closure system as claimed in 7 wherein the action of unscrewing the cap (after removal of the aforesaid pilfer-apparent band) causes fracture of the aforesaid container frangible top section. Said fracture being achieved through the action of a split ring previously sprung over the said top section and retained in position beneath the said top section by the subsequent assembly of the closure in which it is retained. The said split ring would be retained by a snap feature in the case of a plastic ring, or by bonding achieved during exposure to aforementioned magnetic field in the case of a metal ring. This latter method is illustrated in Figs. 1 and 5 of accompanying drawings.

9. A pilfer-apparent closure system as claimed in 8, wherein the fracture of the said membrane joining the top section to the container opening is achieved by means of an annular ring embodying deflectable fingers which is snap fittingly inserted into the cap prior to assembly of said cap to said container. During assembly of cap to container the said fingers deflect outwardly over the top section—then spring inwardly to form an

abutment underneath the said top section.

10. A pilfer-apparent closure system as claimed in claims 1–6 wherein the container is of conventional design having an open top and screw threaded finish as illustrated on Fig. 8 on accompanying drawings.

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